Breast MR Imaging Intervention

Elizabeth A. Morris, MD
Associate Radiologist
Memorial Sloan-Kettering Cancer Center
Dept of Radiology
1275 York Ave
New York City, New York 10021
Tel: 212-639-2236
Fax:212-717-3056
Email: morrise@mskcc.org

INTRODUCTION

The strength of breast MR imaging lies in its ability to detect invasive and pre-invasive intraductal breast carcinomas not seen on conventional imaging. Sensitivity is high for both invasive carcinoma and in some hands in situ carcinoma. However, published specificity ranges from 37 to 97%. Intense investigation into improving specificity with particular attention to morphologic and kinetic parameters has been performed and there is now a BI-RADS™ Lexicon that has been developed. Although this likely will improve specificity, there is realization that overlap between benign and malignant lesions exists regardless of the method of analysis. Future applications such as spectroscopy may improve our ability to detect cancer versus benign disease. But, as it is likely that specificity of breast MR imaging will never be perfect, the ability to biopsy MR imaging-detected lesions is essential. Since MR imaging will detect both invasive and pre-invasive carcinomas not seen on conventional imaging, breast intervention under MR guidance must be an integral part of any breast MR imaging program.

EQUIPMENT

Systems that have been validated for MR intervention are mostly the 1.5 T closed magnets as these allow high signal to noise and the visualization of small lesions. An MR imaging system that allows visualization of small lesions with high enough spatial resolution is needed, so that a needle may be placed accurately. Similarly, an MR imaging system that performs rapidly is needed so that dynamic data can be obtained in addition to morphologic information, which is important in characterizing lesions and determining the need for biopsy.

Closed magnets are more ubiquitous than open magnets and have been the only magnets thus far validated for high quality diagnostic examinations, as the field strength is higher. Therefore, a system for MR-guided biopsy must incorporate the possibility of performing a biopsy in a closed system, requiring that the patient be removed from the bore of the magnet, in order to gain access to the breast to perform an interventional procedure.

Open magnets are of lower field strength than closed magnets and have poorer homogeneity, however, they are advantageous from the point of view that they can offer access to the breast from all angles. Open-access systems also allow interactive real-time needle visualization allowing accurate needle placement.

Techniques

Interventional procedures may be performed free hand or by using guidance systems such as compression grid systems that allows coordinates to be obtained. Open systems that allow real time imaging lend themselves to the free-hand approach as repositioning of the needle can be performed and confirmed in a matter of seconds. The free-hand technique is advantageous as the needle in not in a fixed orientation and can be angled accordingly. In a closed system, the free-hand approach is potentially disadvantageous due to long examination time secondary to repeat imaging, if multiple repositionings are required, as the patient needs to be removed and replaced in the bore of the magnet. Therefore, in a closed system, grid systems that allow more accurate initial needle placement are preferred.

SYSTEMS FOR LOCALIZATION AND BIOPSY

The basic design of breast MR localization/biopsy systems incorporates many of the same techniques of mammographic localization or stereotactic biopsy. To accomplish this, ideally, the breast is immobilized and all parts of the breast are accessible. The breast lesion that is to be localized or biopsied is required to be visualized and needle placement is required to be verified. As the material used in many of these systems is required to be MR-compatible, most systems are designed with plastics.

Intervention of the breast under MR guidance can be performed with the patient in a supine or prone position. Prone positioning is generally preferred as the breast is pendant and away from the chest wall and needle direction is generally parallel to the chest wall. In addition, dedicated breast coils may be used in the prone position. Fixing the breast in the prone position has many advantages including decreased movement of the breast when placing a needle. Fixation of the breast can be achieved by a thermoplastic mesh or by immobilization between two compression plates. Immobilization if the breast tissue for most systems is performed in the medio-lateral plane between compression plates. The compression plates used allow access to the breast from the lateral or medial direction. A variety of compression plates have been manufactured. Compression plates with perforated holes to accommodate needles have been described as well as flexible moveable horizontal bands.

The most common commercially available localization and biopsy device is manufactured by MRI Devices (Waukesha WI). At our institution we use a compression plate consisting of a grid into which a needle guide is inserted in order to direct the needle in a horizontal fashion. These compression plates provide immobilization of the breast as well as a guide that acts as a coordinate system to enable accurate targeting of the lesion. One disadvantage of a grid system or a perforated hole system is that small lesions may lie underneath the area that is not accessible by the holes. If needle localization is being performed, this is usually not a problem as the holes are not more than a few millimeters apart. However, if a biopsy is being performed of a small lesion, the inaccuracy of a few millimeters may prove crucial.

Access to the breast from more than one approach is desirable so that the shortest distance to the lesion is maintained for intervention procedures. Access to medial lesions used to be challenging but most breast biopsy devices these days allow medial access for needle placement. If medial access is not available, the patient can be positioned in a prone oblique position rather than straight prone. For example, to localize a lesion in the

medial left breast, the left breast can be placed in the right breast coil, making the medial aspect of the left breast accessible. The prone oblique position is most successful on women who are healthy and relatively thin.

Some investigators have experienced problems with contrast uptake when the breast is compressed therefore, it is advisable to immobilize the breast rather than compress it. Yet, there are other groups that use compression without problems in contrast uptake. Although controversial, this appears to represent a small number of cases.

A potential problem with MR image-guided localizations relates to the fact that the wire is deployed with the breast in compression parallel to the direction of needle placement. This allows for an "accordion effect" described by Liberman: during compression, structures that were far apart are brought close together, and when compression is released, structures that were close together move further apart. Any error in the depth direction (parallel to the axis of needle placement) can therefore be exaggerated when compression is released. Keeping compression to the minimum necessary to achieve immobilization can minimize the accordion effect.

Needle guidance/Fiducals

To place a needle at the desired location in the breast, the position of the lesion must be related to the overlying grid system. One way to accomplish this is to place a fiducial marker on the grid system somewhere (usually close to the suspected location of the underlying lesion). The fiducial marker can be a vial filled with Gadolinium-DTPA or copper sulfate (CuSO4) inserted into one of the grid holes or a Vitamin E capsule taped to the grid and skin. The fiducial marker is visualized as high signal on the initial post contrast image and the exact insertion site over the lesion can be determined by measuring the lesion location relative to the fiducial. The depth of the lesion from the level of the grid and skin surface can be calculated by multiplying the number of sagittal slices by the slice thickness.

In order to introduce the needle into the breast, an opening in the compression plate is needed. This may be accomplished in several ways. A large opening with free-hand guidance could be performed however is less desirable than other methods as compression is suboptimal and accuracy of placement suffers. A grid system allows some compression to be maintained and allows a needle guide to be inserted into the desired grid hole to facilitate needle placement. Alternatively, the compression plate itself can be perforated with multiple holes at fixed intervals, which guide needle placement. The guides are advantageous in that they allow the needle to remain relatively straight and horizontal to the chest wall.

At this time, needle access is performed in the horizontal direction parallel to the chest wall without the benefit of angulation. The flexible rib system potentially avoids these pitfalls, though breast immobilization may suffer.

MR compatible needles

Several MR-compatible needles for localization are commercially available from Daum Medical Systems (Schwerin, Germany), Cook (Bloomington, IN, USA) and E-Z-EM (Glen Falls, NY, USA). Several manufacturers produce MR compatible true cut biopsy needles such as Daum. Most biopsies are however performed using vacuum assistance using probes that are 9 to 11 gauge. These are available from Suros Surgical Systems (ATEC, Indinapolis, IN, USA), Bard (VACORA, Murray Hill, NJ, USA) and

will be soon available from Ethicon Endo-surgery (Cincinnati, OH,USA) and SenoRx (Aliso Viejo, CA, USA). Although artifact can be a nuisance on MR images, visualization of artifact when performing localizations or biopsies can be used to recognize the presence and position of the wire or needle. Directional vacuum-assisted devices have been shown to decrease atypia and ductal carcinoma in situ underestimation and are advantageous in that the probe is inserted once and a localizing clip may be placed.

INDICATIONS FOR MR IMAGING INTERVENTION

MRI-only detected lesion

Any suspicious lesion seen only on MR imaging should be a candidate for MR intervention. These would include breast imaging reporting and data system (BI-RADS™) 4 or 5 lesions. Numerical categories used: 0: needs additional imaging evaluation; 1, normal; 2, benign; 3, probably benign, recommend six-month follow-up MR imaging; 4, suspicious; or 5, highly suggestive of malignancy. Lesions suspicious or highly suggestive of malignancy have morphologic features that include spiculated or irregular margins, heterogeneous or rim enhancement or clumped enhancement in a linear or segmental distribution . Tiny (1 mm) foci of enhancement or stippled enhancement are morphologic features that should not prompt biopsy. Similarly, masses with smooth borders and homogeneous enhancement are generally not considered suspicious. Classification of suspicious lesions also relies on kinetic features, particularly for lesions with morphologic features considered to be “probably benign”. Lesions that are clearly benign or probably benign are inappropriate for MR intervention.

MRI interventional procedures can sometimes be avoided if the lesion is seen reliably on another modality. For lesions interpreted as suspicious or highly suggestive of malignancy at MR imaging, correlative sonography can be performed to determine if the lesion is sonographically evident and thereby amenable to tissue sampling under sonographic guidance. If the lesion is reliably visualized on sonography or mammography, biopsy can be performed under the guidance of those imaging modalities. Breast intervention with mammography or sonography is less expensive, more available, more comfortable and generally more expeditious.

Lesion size

Because MR imaging will identify small lesions not seen on conventional imaging studies, biopsy systems must provide accurate localization and sampling of small lesions. With available current vacuum systems, biopsy of lesions smaller than 10 mm should be possible. Clip placement can be performed following biopsy to mark the site for possible localization for future excisional surgery. Several clips are now currently available. With current clip technology it is probably not ideal practice to clip the lesion under MRI, then move the patient to US or stereotactic biopsy and blindly biopsy the clip, as clip deployment is not always accurate.

ACCURACY OF NEEDLE PLACEMENT FOR LOCALIZATION AND BIOPSY

Targeting accuracy of breast lesions for both localization and biopsy in multiple series has been shown to be high. The accuracy of needle placement for both localization and biopsy is high and not significantly different from the mammographic literature. Although accuracy was favorable in most series, many investigators found certain lesions close to the chest wall and nipple to be difficult to access.

Additionally, verification of accuracy for needle localization is difficult to prove absolutely as no specimen image can be obtained. Knowledge of MR appearances of breast diseases as well as comfort with issues of concordance and discordance should help the imager assess whether the appropriate area was biopsied. As with mammographic needle localization there is the potential for wire movement. Careful close follow up may also help. Consideration to routine follow up MR examination following a benign biopsy may catch any false negative biopsies however this approach has yet to be validated. In our practice, we perform a 6 month follow up examination for any benign MR vacuum biopsy that is deemed concordant to ensure adequate sampling and no further change of the lesion. If the benign pathologic finding is deemed discordant the patient has an immediate follow up MRI examination to assess for continued presence and documentation prior to surgical removal.

MR INTERVENTION PROCEDURE

MR needle biopsies and localizations are an essential part of a breast MR imaging program. The learning curve is short for breast imagers who are used to performing this type of intervention, as the technique is essentially the same. However, as the procedures are performed with a new modality there are special considerations. Speed becomes more important with this procedure as the contrast agent only stays temporarily in the breast. Generally, the contrast agent remains in the breast long enough to do the procedure in question. If the contrast agent vanishes and washes out, the patient may be safely re-injected in order to see the lesion. Importantly, accuracy is essential as there is no specimen radiograph that can be obtained with the contrast agent still within the lesion.

When performing interventions with MR imaging, it is best to work efficiently and rapidly, as there is limited time following contrast injection to perform the procedure and verify needle placement due to the transient nature of contrast enhancement on MRI. Continued lesion visibility is an issue and most lesions do not remain visible for more than 20 minutes following injection.

Technical support with the procedure as well as the imaging will speed up the process. At our institution a technologist trained in MR imaging sets up the sequences so that time is used efficiently. A second technologist skilled at mammographic intervention helps with the intervention procedure in the magnet. A tray that can be wheeled into the MR suite is prepared ahead of time.

For all procedures, the patient has had a recent MR examination performed at our institution. If there is a finding on an outside examination that may represent a benign or probably benign finding, we will repeat the MR examination prior to scheduling the patient for an MR procedure. Therefore, when the patient arrives for a procedure, the lesion is almost always visible. Before the patient arrives in the MR suite, the films are reviewed and the approach is decided, the depth of the lesion is estimated from the diagnostic examination.

Because there is usually a complete examination performed at our institution, the procedure sequence is designed to be as fast as possible. The entire breast may not be imaged and the field of view is tailored to the area of interest in the breast although the grid of the interventional system and the breast between the grid and the suspicious lesion is always included in the field of view. Because MR interventional

procedures require efficiency, the time to perform these procedures is not excessively long.

Pulse sequences

Pulse sequences are chosen to be rapid so that the abnormality can be identified, followed immediately by intervention to localize or biopsy. Optimal systems would allow fast acquisition and display of images with high enough spatial resolution and precise interventional device localization. Ideally, sufficient anatomic contrast and lesion contrast may allow identification of the lesion after contrast has washed out, if the procedure takes longer than expected. Subtraction imaging is less desirable due to time constraints and possible misregistration from patient motion and tissue movement from needle placement. The ability to rotate the imaging plane in the plane of the course of the needle may be helpful so that visualization of linear low signal identifies precise location of the needle.

The breast is placed centrally in the dedicated breast coil (MRI Devices Corporation, Waukesha, WI) and positioned so that the posterior tissue is maximally brought into the coil. The lateral grid plate of the dedicated biopsy compression device using a grid-localizing system that is a commercially available model (Biopsy-System No. NMR NI 160, MRI Devices Corporation, Waukesha, WI) is then securely placed so that the breast is immobilized so that tissue movement is minimal when a needle is placed. The medial aspect of the breast was first positioned flush against a compression plate. A Vitamin E capsule is then taped over the estimated location of the lesion, based on review of the prior diagnostic MR examination.

The first sequence for an MR intervention procedure that is acquired is a post-contrast image. Gadopentetate dimeglumine (Magnevist; Berlex, Wayne, NJ), 0.1 mmol/L per kilogram of body weight, is injected intravenously as a rapid bolus injection through an indwelling intravenous catheter. The pre-contrast image has already been performed on the diagnostic examination and does not add information for the procedure. The imaging sequence used at our institution is a fat suppressed 3D gradient echo T1-weighted image (TR 17.1/TE 204, angle 35°, matrix 256x192, 1 NEX, 2 mm slice thickness without gap, frequency anterior/posterior direction) obtained in the sagittal plane to allow visualization of enhancing lesions. Sagittal slices are carried out to the grid that is visualized due to the impression that is made on the skin. The Vitamin E marker is clearly visualized at the level of the grid where it is taped to the skin. A cursor is then placed over the lesion in the breast and sequential sagittal sequences are scrolled through on the console in order to identify the location of the lesion on the grid. The skin entry site is determined based on visual assessment of the location of the lesion with respect to the grid lines, using the vitamin E capsule as a guide. The depth is calculated by multiplying the number of slices scrolled through by the slice thickness. Approximately two centimeters are added to the depth to account for the width of the needle guide and the fact that the tip ideally should be no more than one centimeter beyond the lesion.

Prior to placement of the needle, the skin is marked over the area with a felt tip pen and the skin is cleansed with alcohol and anesthetized with 1-2 cc 1% lidocaine HCl (Xylocaine, Astra USA, Westborough, MA). If a biopsy is performed, a small skin nick may need to be made to accommodate the needle. The needle guide is placed in the grid

(Biopsy-System No. NMR NI 160, MRI Devices Corporation, Waukesha, WI) overlying the lesion and the needle is placed to the appropriate depth.

After the lesion is identified on the post contrast image the needle is inserted and the patient is re-imaged in the same limited fashion with the same sequence to document accurate needle placement. There is the option however of acquiring in the axial plane so that the needle trajectory can be visualized in entirety and not sequentially. Once the needle is verified to be in the correct location, localization or biopsy is performed. After documenting accurate placement, the needle is removed and the wire remains in place. After the procedure, the patient is then re-imaged a final time to either document placement of the wire for needle localization or to evaluate the biopsy cavity.

Following MR imaging localization, a mammogram is performed to document wire position before the patient goes to the surgical suite.

Verification of biopsy

During the biopsy procedure, verification of biopsy can be performed under real time. If the biopsy is performed in a closed system, a repeat MR scan after the procedure will usually document the biopsy cavity and assessment of adequacy of tissue sampling is possible. If there is discordance between the pathologic and mammographic findings, a postbiopsy MR to assess the biopsy site may be indicated. In the immediate postbiopsy period, residual disease can be seen if it is separate from the biopsy cavity or if it is large enough that the postbiopsy enhancement from granulation tissue does not obscure the residual disease. It needs to be remembered that postsurgical inflammation around the biopsy cavity can obscure small residual disease. A post-operative MRI after surgery should be obtained in any case where imaging and pathologic discordance arises.

Confirmation of lesion retrieval when surgery is performed is difficult, as contrast enhancement within the lesion does not persist. Once the lesion is removed, routine specimen radiography is usually not helpful as the lesion is generally occult mammographically. MR imaging of the specimen has met with limited success and is generally not feasible due to the fact that the lesion does not enhance ex-vivo. Specimen MRI techniques are not yet developed however, several potential methods have been proposed. Contrast agents that are retained in the tumor for long periods may be identified on specimen x-ray. MR spectroscopy may play a role for verification of lesion removal. Other alternatives include carbon or dye. Liberman et al. have suggested the placement of a localizing clip at the site of biopsy to use as a marker to confirm lesion retrieval.

A technique of marking the lesion or biopsy site that is visible on mammography or sonography would potentially serve several purposes. If the lesion is marked with a substance that did not diffuse, biopsy or localization could theoretically be performed outside the MR suite under mammographic or ultrasonographic guidance. Additionally, if the patient is having a surgical procedure, a substance that marked the lesion site could verify lesion removal at specimen radiography.

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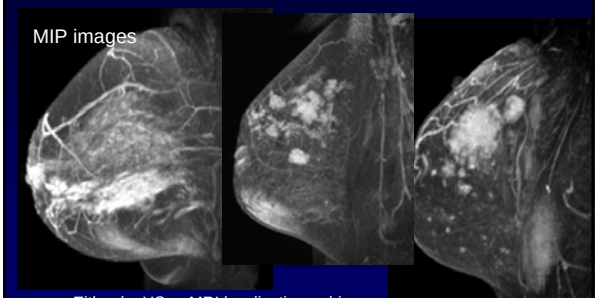
Breast intervention under MR guidance

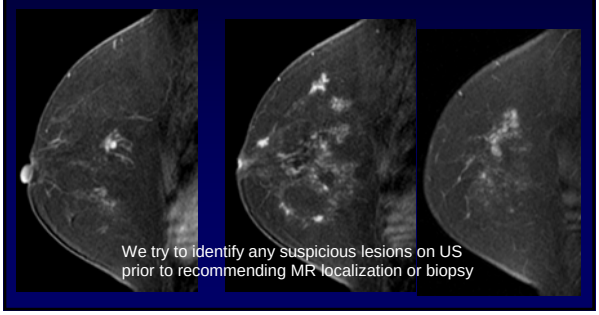
Elizabeth A. Morris, MD
Associate Radiologist
Memorial Sloan-Kettering Cancer Center
New York City, NY

How to sample a suspicious area?



Either by US or MRI localization or biopsy

Multicentric carcinoma - mastectomy



We try to identify any suspicious lesions on US prior to recommending MR localization or biopsy

Significance of a targeted sonographic correlate (n=93)*

US correlate in 21/93 (23%)

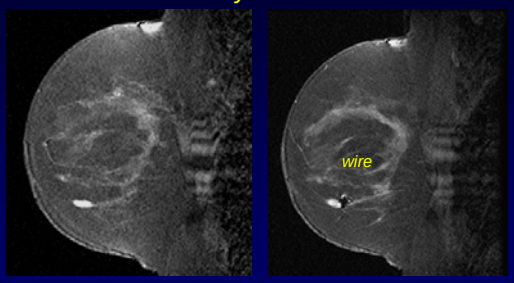
US correlate - higher (43%) frequency of carcinoma

No US correlate - 14% yielded carcinoma

Absence of a correlate does not spare biopsy!

**LaTrenta Radiology 2003;227:856-861*

Screen detected cancer - not possible to rely on solely on US



9mm IFLC screen detected – not seen on US

Correlative US

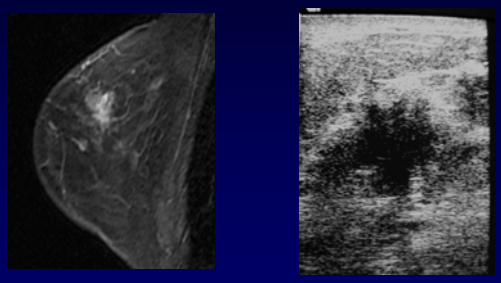
Position of lesion may be different
- MR performed prone
- US performed supine

Lesion size and morphology should be similar

Distance from nipple most reliable measurement

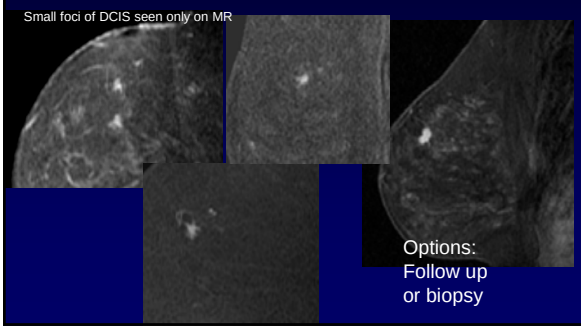
If any doubt, MR intervention

Correlative US



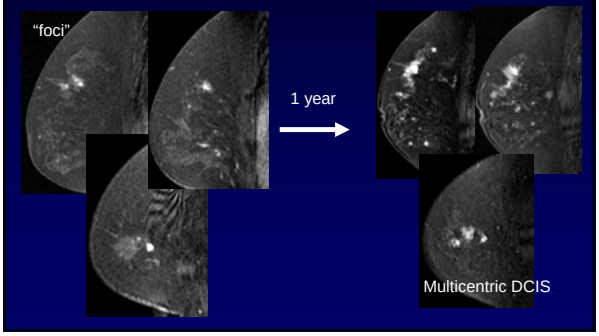
Upper inner quadrant lesion – irregular 2 cm mass

What if a suspicious lesion has no US correlate?



Options:
Follow up
or biopsy

Follow up in one year



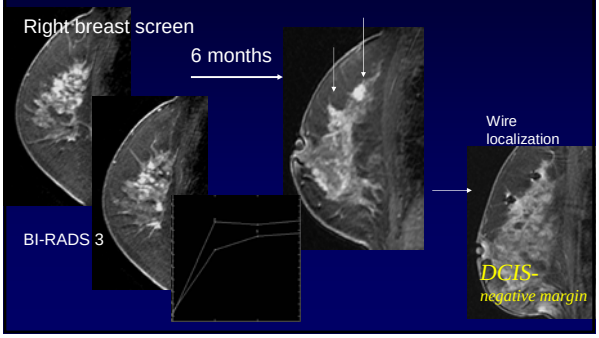
What lesions should we be following?

- No clear cut way to manage these at this point
- If not comfortable passing, then 6 month follow up may be reasonable
- Needs to be studied

*In our experience, 10% of lesions recommended for follow up in a screening population were malignant**

**Liberman et al Cancer 2003*

Follow up in 6 months



MRI intervention - grid system

our magnet is closed
- real-time imaging not an option

repositioning not an issue
- decreases amount of magnet time

breast is stabilized
- advantageous for dense breasts/small breasts

needle approach is mostly parallel to chest wall
- minimizes complications

Imaging and interventional coil

Allows medial access & bilateral simultaneous localization

Needle guide stabilizes needle and decreases needle deflection – width of guide is 2 cm.

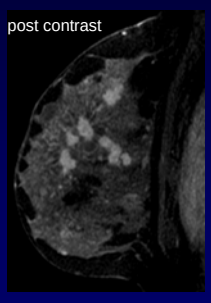
Advantages of needle guide

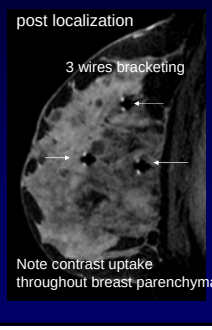
- needle guide minimizes needle deflection
  - dense breasts
  - deep lesions
- helpful in biopsy procedures
  - needle guide can support weight coaxial needles
- may not be necessary for straight-forward localization
  - free-hand localization is an option

MR intervention challenges

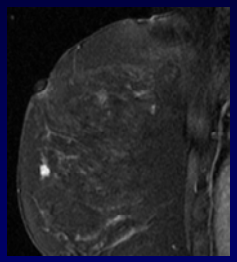
- learning curve
  - short for mammographers
- speed and accuracy important
  - vanishing target – contrast wash-out
- no specimen radiograph
  - contrast no longer in tissue
- MRI and pathologic discordance
  - post-operative MRI

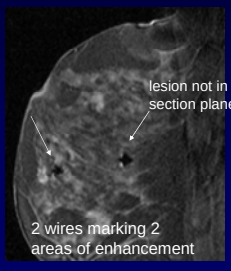
Wire localization of occult multifocal carcinoma





wire localization of screen detected DCIS





Increasing efficiency to increase speed

target interested MR technologist
- MR expertise ensures quality of examination
  - decreases chance of inadequate fat suppression etc.
- increases speed of procedure
  - less repetition of sequences

involve mammography technologist
- positioning to ensure lesion visualization
- patient assurance during procedure
- interventional procedure experience-trouble shooting
- tray preparation

MR needle localization preparation

Patient preparation – MD or technologist

Pull breast into coil before placing grid

Medial plate moved firmly against medial breast

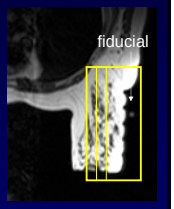
Lateral plate firmly placed and fiducial marker (Vit E) applied

Acquisition – tips to speed up imaging

pre-contrast sequence not necessary

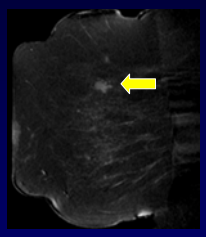
imaging entire breast not necessary
- image fiducial and lesion

can use greater slice thickness to decrease imaging time
- 3-4 mm instead of 2mm



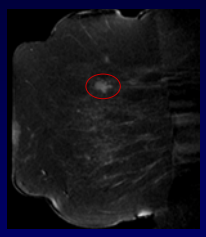
Identification of appropriate grid box

1. Identify lesion



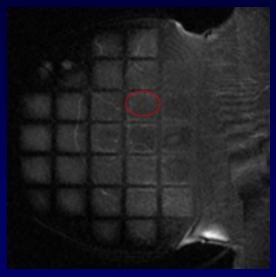
Identification of appropriate grid box

1. Identify lesion
2. Mark lesion



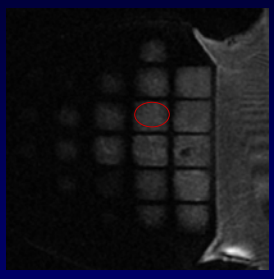
Identification of appropriate grid box

1. Identify lesion
2. Mark lesion
3. Scroll to grid image



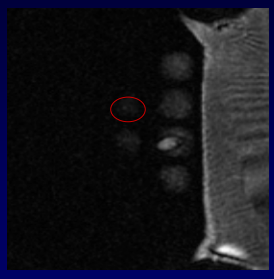
Identification of appropriate grid box

1. Identify lesion
2. Mark lesion
3. Scroll to grid image

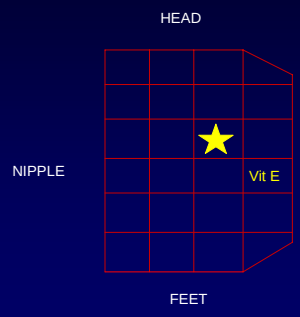


Identification of appropriate grid box

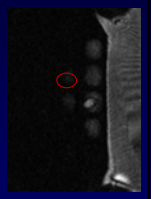
1. Identify lesion
2. Mark lesion
3. Scroll to grid image
4. Relate vit E to appropriate box



The radiologist's guide

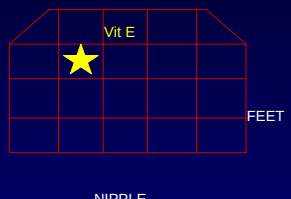


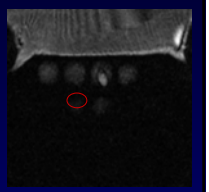
CHEST WALL



The radiologist's guide

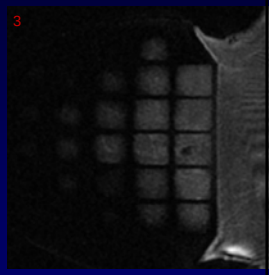
CHEST WALL





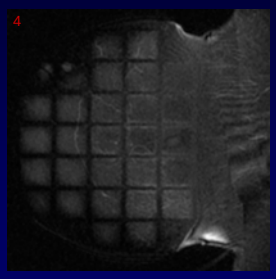
Calculating depth of lesion

- Count the number of slices from the grid image to the lesion.



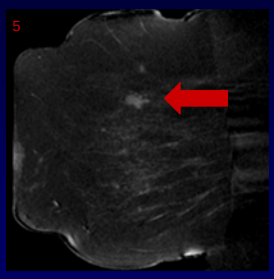
Calculating depth of lesion

- Count the number of slices from the grid image to the lesion.



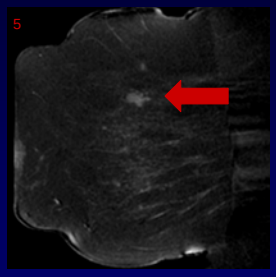
Calculating depth of lesion

- Count the number of slices from the grid image to the lesion.



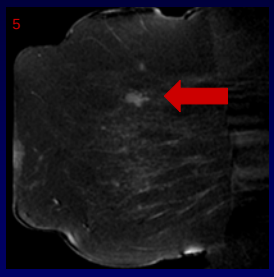
Calculating depth of lesion

- Count the number of slices from the grid image to the lesion.
- Multiply the number of slices by the slice thickness 2x3mm=6



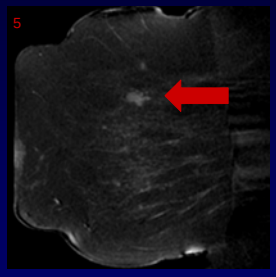
Calculating depth of lesion

- Count the number of slices from the grid image to the lesion.
- Multiply the number of slices by the slice thickness 2x3mm=6
- Add the thickness of the needle guide: 6+20mm=26mm



Calculating depth of lesion

- Count the number of slices from the grid image to the lesion.
- Multiply the number of slices by the slice thickness 2x3mm=6
- Add the thickness of the needle guide: 6+20mm=26mm
- Add 10mm beyond the lesion: 26+10=36mm



Wire localization procedure

Area over lesion anesthetized

Needle placed to calculated depth

Image to confirm x, y & z co-ordinates

Needle artifact should extend 5-10 mm beyond lesion

Considerations with wire position

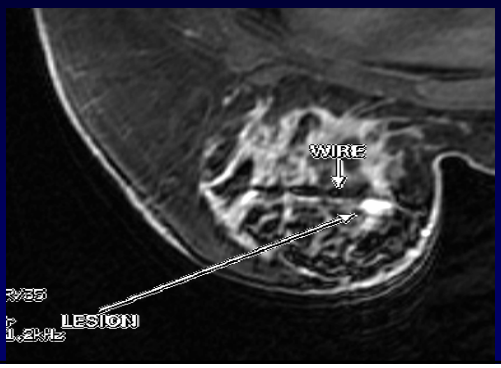
accordian effect

- consider imaging with breast out of compression to document position

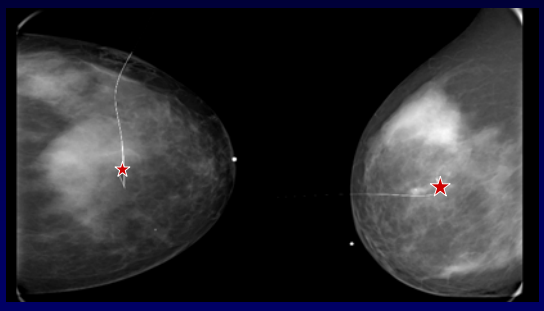
needle artifact

- different manufacturers and different MR microenvironments will produce different artifact
- consider testing with phantom to know what artifact is to be expected on your magnet

Confirmation of wire position



Post localization mammography

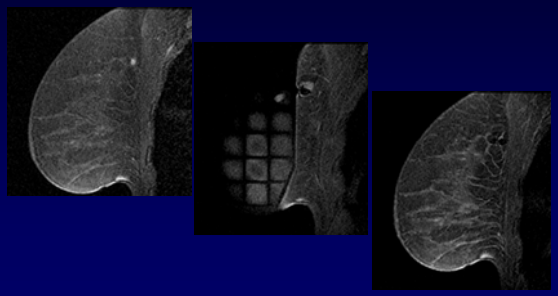


MRI guided needle localizations

AUTHOR	YEAR	CASES	TECHNICAL SUCCESS	PPV
KUHL	1997	97	98%	54%
DANIEL	1998	19	100%	42%
FISCHER	1998	130	98%	48%
OREL	1999	137	98%	43%
MORRIS	2001	115	100%	31%

The PPV of MR (31-54%) is similar to the PPV for mammography

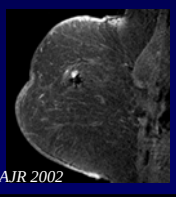
Trouble shooting: lesion outside grid



Freehand localization

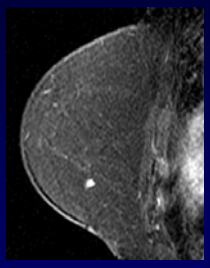
Auditing your practice: preliminary results MSKCC (n=100)*

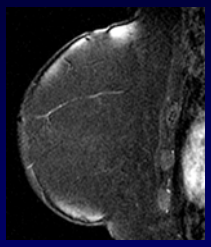
- 33% malignant
  - 50% in situ (DCIS)
  - 50% invasive



Morris et al AJR 2002

Lesion disappears on the day of the procedure < 5% of time



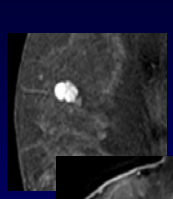


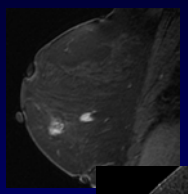
Ensure no technical malfunction or contrast administration mishap
Ensure return of the patient

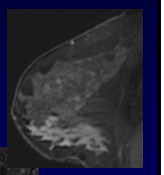
Assessment of concordance

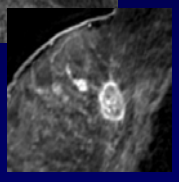
every localization or biopsy
important given no specimen radiograph
post-operative MR
better done sooner rather than later

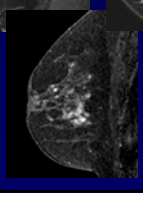
Concordance assessment



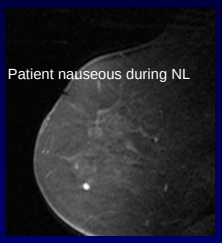




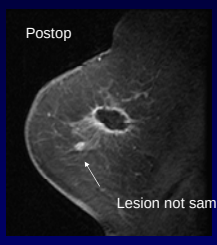




Assessment of concordance/discordance

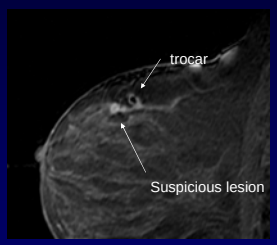


Path: LCIS

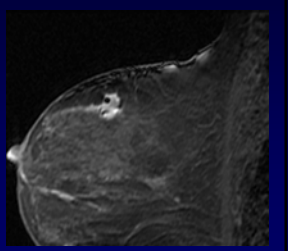


Final Path: 3 mm ILC

MR biopsy concordance

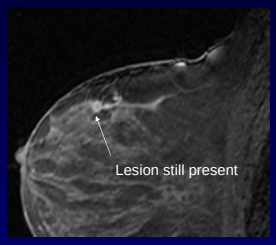


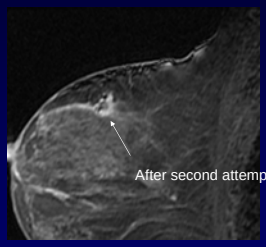
Trocar in place for biopsy



Hematoma following first biopsy

Rebiopsy after lesion confirmed to be still present





Repeat imaging

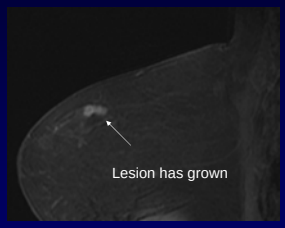
Hematoma obscures lesion

Pathology

Benign breast parenchyma with fibrocystic changes

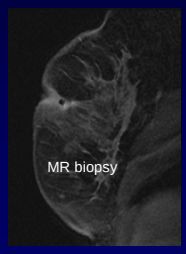
concordant or discordant?

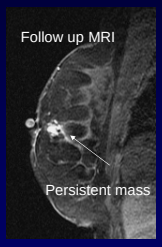
Post MR biopsy follow up at 6 months



Final pathology: 5 mm IDC with negative sentinel nodes

MRI biopsy

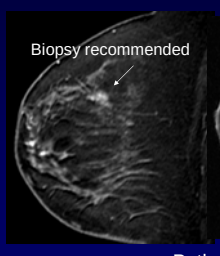


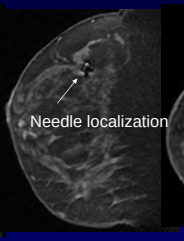


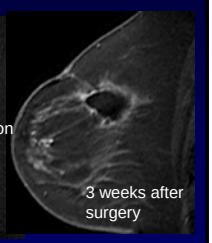
Path: Benign breast tissue & fibrosis

MR localization:
5 mm IDC
Neg nodes

Post-operative MR to document lesion retrieval

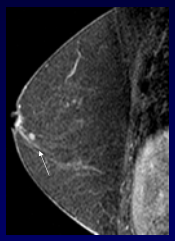


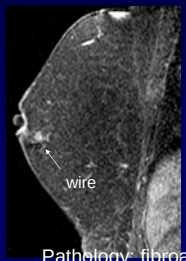


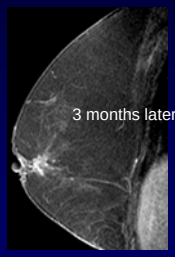


Path: Duct hyperplasia

If delayed post-operative MR may raise more questions than give answers





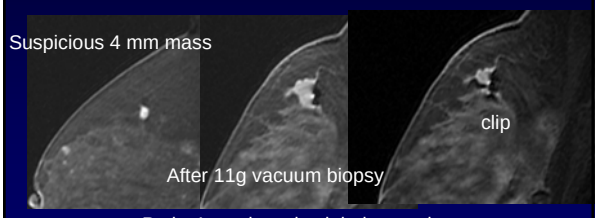


Pathology: fibroadenoma

Advantages of MR directed vacuum assisted device

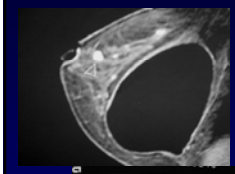
- Fast acquisition
- No firing
- Tiny lesions targeted
- Clip available
- Large cores

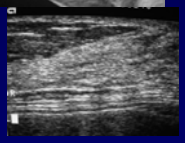
Vacuum biopsy under MR guidance



Path: 4 mm invasive lobular carcinoma removed entirely at vacuum biopsy

MR lesion requiring biopsy-placement of introducer





Placing vacuum probe & retrieving samples

MRI guided breast biopsy

AUTHOR	YEAR	CASES	NEEDLE SIZE	TECHNICAL SUCCESS	MALIGNANCY
FISCHER	1998	31	18G	90%	26%
HEYWANG	1999	100	11G	99%	25%
KUHL	2001	78	14G	98%	35%
PERLET	2002	341	11G	98%	25%
LIBERMAN	2003	20	9G	95%	32%
LIBERMAN	2004	38	9G	87%	27%

Conclusion : MRI breast biopsy is an accurate technique

False positive rates of localization & biopsy

PPV similar or better than mammography in a high risk population

Audit your practice

THANK YOU FOR YOUR ATTENTION

D David Dershaw MD
Laura Liberman MD
Andrea Abramson MD
Jennifer Kaplan MD
Jennifer Menell MD
Lia Bartella MD

Doug Ballon PhD

Cynthia Thornton RT
Richie Fischer RT
Greg Nyman RT
Young-Duk Paik RT
Karen Larsen RT
Indira Gonzales RT